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Alternative Trading Systems and Liquidity.

by

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DISCUSSION
PAPER

Alternative Trading Systems and Liquidity

by

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I. Introduction

Traditional exchanges face enormous challenges. Technology, deregulation and investor needs are driving forces reshaping the trading landscape throughout the world. Technological progress not only allows direct access at traditional exchanges. It also enables to erect new market places, called “Alternative Trading Systems” (ATS). A general definition of ATS is “a trading mechanism developed independently from the established market places and designed to match buyers and sellers on an agency basis” (Salomon Smith Barney, 2001). The purpose of this paper is to review the importance of ATS and their impact on the liquidity at traditional market places.

ATS have gained success in the U.S. after the introduction of new Order Handling Rules in 1996 followed by “Regulation ATS” in 1998. The latter regulatory measure mainly improves the linkages between traditional markets and ATS by requiring ATS to become self-regulatory organization members. We will show that in the United States ATS have been particularly successful in attracting trade in the Nasdaq dealer market whereas they are less successful in competition with the NYSE. In Europe, traditional trading market places automated earlier than in the United States. Moreover, continental European exchanges are typically organized as auction systems implying an agency nature of trading. The liquidity externality then makes it more difficult for ATS to develop a successful business model in Europe.

The market microstructure of ATS and traditional market places is a major determinant of their future success. This literature is mainly concerned with the process by which investors’ latent demands are ultimately translated into transactions. Given the different driving forces transforming the trading landscape, market microstructure helps in judging the relative merits of the different designs of the ATS. It also helps in making projections on their impact on liquidity at the traditional market places.

The remainder of this paper is organized as follows. Section II starts by offering evidence on the impact of technology/automation on trading costs. Section III develops a typology of traditional exchanges and ATS. The fourth section deals with the relation between ATS and liquidity. The final section concludes.

II. Technology and trading costs

Domowitz (2001) argues that the automation of traditional financial markets plays an important role in the evolution of the industrial organization of the trading services industry. He propounds that markets are firms with network externalities related to liquidity. Although the link between liquidity and trading costs is well known, he is the first to investigate the connection between the automation of market structure and trading costs.

Table 1 provides an overview of the trading costs for the period 1996-1999. The execution costs are based on data gathered by Elkins/McSherry and were published in Institutional Investor.[1]

<insert Table 1 about here>

Transactions costs are falling worldwide, illustrated by the decline of the average total trading cost from 73 basis points in 1996 to 61 basis points in 1999. Explanations include competition for order flow, shifts of trading strategies to accommodate liquidity differences, more institutional trading, and pressure from new trading systems and regulatory authorities.

Domowitz investigates whether the adoption of an automated trading technology on traditional exchanges actually contributes to trading cost reductions. He sheds light on

[1] Elkins/McSherry receive trade data on all global trades by institutional traders and compute measures of trading costs. The data consist of average total trading costs – execution commissions, fees and market impact (difference between the price of a stock trade and the average of that stock's high,

this issue at an international level (42 countries). In this section we first briefly summarize the methodology used in this study and its main results. Next, our own empirical results specifically for Europe will be presented.

II.1. International empirical evidence

Domowitz uses the Elkins/McSherry data on trading costs. This allows him to make a distinction between explicit and implicit costs. These are respectively related to development and operating costs[2] (i.e. fees and commissions), and to the dissemination of information on liquidity[3] (i.e. indirect trading costs like price impact costs, including the bid-ask spread). Evidently, the various cost components may be linked to each other. For example, minimizing price impact may imply incurring higher commissions. The link between automation and savings in explicit trading costs is quite obvious. Implicit trading costs, however, are at first sight not directly related to the automation of the market structure as liquidity is only created by the traders' presence on the system. But obviously, an automated market system indirectly affects liquidity as its design affects traders' incentives and capacities to monitor the market. Therefore, automation may shape the properties of transactions prices and market efficiency.

Next, Domowitz tests whether total trading costs and its components depend on the adoption of an automated trading technology by using regression-based techniques. As control variables, volatility, turnover and market capitalization are used. The regressions are performed on a quarterly, cross-sectional basis for all the countries in the dataset in the period from 1996:4 to 1998:3. Some of these countries do have exchange facilities that are largely automated with respect to execution while others do not.

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low, opening and closing prices during the day) – as a percentage of trade value for active managers in a universe of 42 countries.

[2] Trading floor development costs for instance were calculated to be two to forty times as expensive as those for electronic market places.

[3] On automated markets the electronic order books are open for insight to all clients allowing for an optimal active liquidity management to control implicit transactions costs.

The results for the international sample indicate that markets that are largely automated have average total trading costs that are, ceteris paribus, 33 to 46 basis points lower than those of their non-automated counterparts. Both types of cost components, explicit and implicit costs, hinge on automation. Explicit costs are between 23 to 32 basis points lower, whereas implicit costs are 10 to 18 basis points lower. Thus, on an international level the automated trading market microstructure does seem to have an effect on costs. This difference might be related to the higher floor development costs on non-automated exchanges[4].

Domowitz (2001) discerns why the automation of markets permits the realization of implicit cost savings. By which means do electronic market systems allow traders to reduce price impact costs? One answer to this question is the presence of an electronic limit order book. Via this tool that characterizes automated markets, traders can easily and instantly monitor certain liquidity characteristics (i.e. strategic liquidity management (see footnote 3)). This allows traders to execute their transactions when the market is rather liquid implying a reduction of transactions costs. Indeed, in reality the data indicate that traders do tend to use the electronic system to monitor liquidity and trade in a strategic way using this information. The price impact of realized trades is much smaller than that of trades executed under a naïve trading strategy that ignores monitoring of the book and stays almost constant along different trade sizes.

II.2. Empirical evidence for Europe

The analysis of automation in Europe on the basis of the Elkins/McSherry data is rendered somewhat trickier. The reason is that traditional European stock markets are technologically advanced and many exchanges were already electronic since 1996, which is the starting date of the Elkins/McSherry dataset. However, as can be seen from Table 2, there are some notable exceptions.

<insert Table 2 about here>

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[4] Other reasons include industry and regulatory related matters.

In order to compare our results with those of Domowitz (2001), we replicate his regression for the European countries only. More specific, we estimate the following equation:

$$TradingCost_{it} = b_0 + b_1 AutomationDummy_{it} + b_2 MarketCapitalization_{it} + b_3 Volatility_{it}$$
$$+ b_4 Turnover_{it} + b_5 YearDummies + e_{it}$$

The results are displayed in table 3:[5]

Table 3: Impact of electronic trading systems on trading costs in Europe

Dependent variable	**Total costs**	**Implicit costs**	**Explicit costs**
Electronic trading dummy	-7.82 (2.72)	-3.29 (1.78)	-4.52 (1.59)
# country-years	52	52	52

Legend: OLS estimates of the three proxies of trading costs (total, implicit and explicit costs) on an "electronic trading dummy" and other control variables (market capitalization, volatility, turnover and year dummies). Standard errors are in parentheses.

The results in table 3 show a significant negative coefficient for the electronic trading dummy. The interpretation is that in automated markets total trading costs are about 8 basis points lower.[6] The savings in explicit trading costs are somewhat higher than those in implicit costs. Although the results should be carefully interpreted due to the low number of countries and the short time period, they confirm the negative coefficients obtained in Domowitz (2001) for 42 countries. However, the magnitude of our coefficients is substantially smaller than the conditional savings in international trading costs due to automation as reported in Domowitz (2001). In particular, he reported total costs savings of 33 to 46 basis points, explicit cost savings of 23 to 32 basis points, and implicit cost savings of 10 to 18 basis points. These are about 5

[5] Data are taken from the FIBV website. Volatility is measured as the standard deviation of the monthly returns on the countries' stock index. Turnover is proxied by total trading volume divided by total market capitalization.

[6] Other specifications show that the magnitude of the coefficient is fairly stable. However, the electronic market dummy not always turns out to be statistically significant. Moreover, the control variables do not always show the expected sign.

times larger than the results obtained for Europe only, which suggests that the impact of automation is less pronounced for this continent. Two explanations may drive these differences. First, it is possible that the automation dummy may only capture another step towards a full electronic market. A second explanation is that the "automation dummy" in Domowitz may also capture agency trading or deregulatory effects. Agency trading is dominating in (Continental) Europe even when automation was not yet in place.

III. Typology of traditional markets and alternative trading systems (ATS)

The market microstructure literature typically distinguishes *dealer markets* and *auction markets.* Market makers are the only providers of liquidity in dealer markets. They are a counterparty in all transactions and quote two prices: the bid price, at which they are willing to buy securities and the ask price, at which they will sell. The difference between those two prices is the market maker's spread. This spread hinges on the degree of asymmetric information between the dealer and informed traders, inventory costs and the remuneration for the service of providing immediacy (see Glosten and Milgrom (1985), Ho and Stoll (1981) and Demsetz (1968), respectively). An example of a dealer market is Nasdaq. On auction markets, on the contrary, investors trade directly with each other or with the intervention of a broker dealer acting as an agency trader only. All unexecuted orders are gathered in a limitorder book. Market orders consume liquidity. Limit orders that do not execute immediately supply liquidity and could therefore be seen as free (short-lived) options against which market orders can be executed. Examples of auction markets are Euronext and the Toronto Stock Exchange. Other important characteristics are the degree of continuity of the exchanges, the degree of price discovery and the transparency (see Madhavan (2000) for a review). Some only operate at certain points in time during the day whereas others are continuous.

There is a wide variety in alternative trading systems (ATS). In referring to ATS we exclude the established market places (traditional exchanges) as well as "internal netting systems" (organized by individual intermediaries). A typical aspect of ATS concerns the fact that buyers and sellers meet on an agency basis.[7]

Within the ATS, we distinguish three groups of networks for which we will present a brief description of their typical features[8].

A first important category is *Electronic Communication Networks* (ECNs). Weston (2001) describes ECNs as "electronic trading systems that allow investors to clear trades through an open limit order book. Rather than place orders with a specialist or dealer, traders on ECNs may anonymously submit orders and trade with each other directly." A typical feature is that brokers on this communication network are acting on an agency basis only. ECNs allow traders to submit priced trades, i.e. limit orders. Therefore, ECNs have the potential to contribute to price discovery. Most ECNs guarantee pre- and post-trade anonymity.

A second category of ATS are external *Crossing Networks.* The SEC (2000) defines crossing networks as "systems that cross multiple orders at a single price and that do not allow orders to be crossed or executed outside of the specified times". Crossing systems thus only trade at scheduled times, as opposed to the continuous trading of exchanges or other ATS. Since traders enter unpriced buy or sell orders, crossing systems do not contribute to price discovery. Execution risk remains at crossing-networks since the trade is not necessarily executed. The intuition is that excess demand or supply may result. The advantage of a crossing network is that it minimizes market impact. Trades are typically executed at the midpoint of the bid-ask spread in the primary market. According to SSB, crossing networks cater to institutional investors placing larger sized orders in less liquid securities. Examples of crossing networks for Europe include ITG's POSIT or E-Crossnet. Other crossing systems use an auction procedure (e.g. Arizona Stock Exchange). They are similar to the batch auctions used at traditional exchanges as they match buyers and sellers at the same price in maximizing the matched volume.

[7] A notable exception is Jiway, which allows dealers to be dual capacity traders, i.e. also to trade on their own account.

[8] The distinction between the different types of ATS is not always clearcut. For example, electronic communication networks often also offer SORT technology.

A third type of ATS applies *Smart order routing technology* (SORT). These are systems developed by a variety of market participants that are used to route orders to centralized markets based on trading criteria that seek to provide best execution for the client. This execution can be on a traditional exchange or on an electronic communication network. The trading criteria can be price improvement or execution speed.

ATS are evolving quickly and their future remains quite uncertain. SSB distinguishes several business models for ATS. Some of them move to become a *destination exchange* (e.g. Tradepoint into Virt-X, Archipelago). This implies that the ATS becomes an organized market allowing them to become a destination for listed shares. Another business model is to become a regular broker at several exchanges, i.e. a *destination broker-dealer*. This essentially happens with SORT that should be able to provide execution at several places (e.g. Instinet, a subsidiary of Reuters Company, has become a member at 18 exchanges). It is clear that some new market places offer several of the types of ATS discussed. For instance, ITG is offering an ECN and a crossing network. Moreover, some of the specific aspects of ATS have been already incorporated into the traditional exchanges (NYSE direct+ offers a crossing network).

IV. Alternative Trading Systems and Liquidity

In this section, we will first discuss US-evidence on ATS and liquidity. Next, some evidence for Europe will be presented.

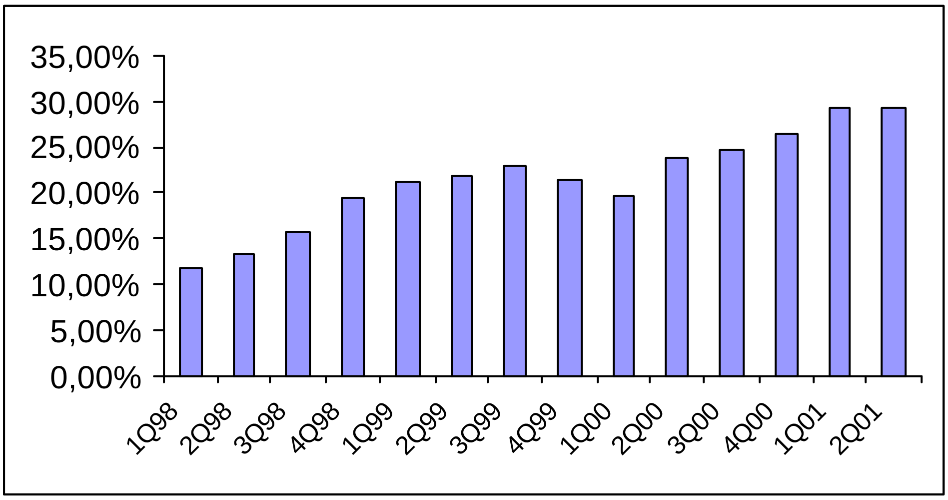
IV.1. Empirical Evidence for the United States

IV.1.1 Importance of ATS

Table 4 provides an overview of some main characteristics of the most important ECNs in the United States. The market shares of the ECNs are presented in figure 1.

<insert Table 4 about here>

Figure 1: Nasdaq Share volume of ECNs



Source: Nasdaq and websites of ECNs

Most ECNs started operating in the late nineties. Nine of them are currently still active. Jointly, they attract about 29 per cent of total share volume on Nasdaq (second quarter of 2001), a number that has been steadily increasing from 12 per cent in the first quarter of 1998. According to Weston (2001), two causes can be discerned for this growth pattern. First, the changing SEC regulations are an important determinant. For instance, the so-called "Order Handling Rules", introduced in 1997, increased competition because public limit orders were since then allowed to compete directly with Nasdaq market makers. Also market makers posting orders on ECNs were since then obligated to make those orders available for the public as well. This forced dealers to provide greater access to ECNs for public investors. Moreover, ECNs have been more successful in attracting trade from Nasdaq. The intuition is that ECNs offer an agency alternative eliminating the spread charged by dealers. The NYSE is already an auction market (with a specialist) and enjoys an incumbency advantage due to the liquidity externality. Secondly, also the advances in technology have played a tremendous role. As argued in the previous section, the trading systems were less advanced compared to many European exchanges. This allows the ECNs to attract a significant part of the market.

An interesting feature of ECNs is that important broker/dealers have become important shareholders of ECNs. Milbourn, Boot and Thakor (1999) offer one explanation for this evolution.[9] Although the future of ECNs is highly uncertain, broker dealers are willing to accept relatively low returns for the moment. The potential vital role of ECNs in the future defines these ownerships as a strategic option. Moreover, in the action of attracting order flow by institutional investors or retail investors, ECNs develop strategic partnerships with online brokers and broker/dealers. This ultimately determines the success of their business plan. All ECNs offer at least an internal limit order book. Most of them also offer SORT; that is they route orders to either other ECNs or dealers. Two of the ECNs have an exchange application pending. The most successful ECN in terms of Nasdaq stocks is Instinet. It attracts about 13 per cent of Nasdaq share volume during the last quarter of 2000. Another important player in terms of Nasdaq volume is Island with 7 per cent. The other ECNs have a market share in Nasdaq volume of less than 2 per cent.

Next to the nine ECNs, there are some crossing networks already operating in the U.S. and some are announced. The Arizona stock exchange organizes since 1990 single price auctions four times a day. Its volume however is fairly low. ITG's POSIT was launched in 1987 and crosses seven times a day. It is the largest crossing network in the U.S. Two very recent crossing systems are Primex Trading and Wofex. Primex Trading exposes certain orders for auction-style competition. Prices may be away from the best quotes in the National Market System. Wofex essentially adds SORT to a crossing network.

IV.1.2. Market quality / liquidity

For the United States, there are already some studies describing the behaviour of ECNs and their impact on the market quality / liquidity on traditional exchanges.

[9] Note that they apply it in a different context, namely the diversification of banking activities.

These include the following : Huang (2000), Hendershott and Mendelson (2000), Simaan, Weaver and Whitcomb (1998), Domowitz (2001), Barclay, Hendershott and McCormick (2001) Weston (2001), Conrad, Johnson, and Wahal (2001), Benhamou and Serval (2000), Domowitz, Glen and Madhavan (2001), Domowitz and Steil (1999) and Naes and Odegaard (2001). In most of these studies, the traditional market under consideration is Nasdaq as ECNs have proven to perform best for shares noted on this exchange (cfr. infra). In this subsection, we will briefly describe and compare the main results of some of these studies. This will be done focusing on four aspects of market quality/liquidity, namely bid-ask spreads, depth of the market, informational efficiency and price discovery.

1) Bid-Ask Spreads

Weston (2001) investigates whether the increased market share of ECNs leads to tighter spreads (monthly average quoted, effective and relative spreads for stock i in month t), i.e. whether ECNs have a significant negative impact on spreads on traditional markets. For this purpose, he performs the following regression using a long time-series and large sample of firms[10] :

$$\ln(Spread)_{it} = a_i + b_1(ECNdummy)_{it} + b_2\ln(ECNshare)_{it} + b_3\ln(\mathrm{Ref}orms)_{it} + b_4\ln(Size)_{it}$$

$$+ b_5\ln(Turnover)_{it} + b_6\ln(Volatility)_{it} + b_7(numberoftrades)_{it} + e_{it}$$

The variables “ECNdummy”, indicating ECN activity in a given stock-month, and “ECN market share” allow to test the effect of ECN activity on spreads. The variable “Reforms” is included to capture possible spread effects of any market reforms (i.e. Order Handling Rules). The independent (control) variables in this model were chosen according to Stoll (1997) and Wahal (1997). They are used to capture well-known determinants of bid-ask spreads, and of execution costs in general. For instance, the selected size variable controls for the fact that orders that are large

10 This is a multivariate fixed-effect model that allows for within-firm variation in the parameters to account for unobserved heterogeneity in liquidity for the sample of firms.

relative to normal trading volume are likely to have higher execution costs because of adverse selection effects. Log transformations of these variables are used to reduce the skewness.

The b_1- and b_2-coefficients are of interest to us and are consistently negative and statistically and economically significant for all specifications (i.e. for the three kinds of spreads). This implies that ECNs induce competitive pressure on the Nasdaq market. The exact number for the b_1 -coefficient in the average quoted spread regression is equal to -0.0041, implying a 4 percent ceteris paribus decrease for this spread measure. For the effective and the relative spread, this decrease amounts 10 and 7 percent respectively. The b_2-coefficient indicates that a one percent increase in ECN activity lowers the average quoted spread by 0.714 percent. For the effective and the relative spread, this decrease amounts 0.917 and 0.07 percent respectively. Weston argues these results are particularly strong because the data used actually give an underestimation of the true impact due to the manner in which volumes are reported to the Nasdaq (cfr. supra). Note, however, that they are only valid for small trades, not for block trades.

Thus, in addition to regulatory market reforms, the growth of ECNs has helped to significantly lower trading costs. As such, it has mitigated the negative effects of the suspected imperfect competition among Nasdaq dealers (e.g. Huang and Stoll (1996), Christie and Schultz (1994), Weston (2000))[11].

Domowitz (2001) constructs an *American* sample by gathering data from institutional investors. For this dataset, total trading costs for executions by institutional investors through ECNs and through traditional brokers and markets are compared[12]. Calculated yearly savings from 1993 through 1996 using automated systems vary from 31 to 65 percent, relative to trades executed by traditional brokers or dealers.[13] Domowitz even manages to invalidate the conventional wisdom that automated trading venues are

[11] This is supposed to be due to practices such as payment for order flow and preferenced trading used by traditional dealers to attract order flow through non-price competition. Thus, large spreads are prevented from from being competed away (Weston (2001)).

[12] Note that total trading costs also include price impact, determined as a geometric average of realized and effective spreads, and measured relative to short-run industry performance.

[13] Average savings amount to 46 percent.

cheaper only because "easier" trades are more often sent to them as he proves that even for more difficult trades, savings from automated execution are evident[14].

This empirical evidence is also consistent with Conrad, Johnson and Wahal (2001), although they use a somewhat different approach. They determine what the difference in realized execution costs is between external crossing systems (POSIT or an after-hours cross on Instinet), ECNs (Instinet) and traditional markets (NYSE, Amex or Nasdaq). These three trading systems are engaged in a competition for order flow. In their dataset[15], the distinction is made between single and multiple mechanism orders, which are respectively orders that are completely executed by a single trading system (91 percent of all orders) and those in which trades are filled by more than one trading system (9 percent of all orders). Note that there is considerable time series variation, but no trend in the distribution of single mechanism orders. Further, the data show substantial differences in size between orders executed on the three mechanisms. Order fill rates are lowest for crossing systems as it concerns a mere function of liquidity on the system (cfr. contra-side depth), which is exogenous to the trader. As traders on ECNs and on traditional broker systems can trade anonymously, they endogenously increase the probability of a fill. Evidently, multiple mechanism orders have the largest execution costs, as they are most difficult to fill.

As in Domowitz (2001), total execution costs are measured as the sum of implicit and explicit costs. Obviously, comparing execution costs between different trading systems univariately can be quite misleading as the trading mechanisms may represent varying degrees of aggressiveness on the part of the institution[16]. One needs to take the differences in order characteristics between these systems into account. For instance variation in order difficulty and other characteristics influencing liquidity and thus trading costs. These are controlled for using two methods, i.e. a "matched-

[14] Domowitz defines more difficult trades as having above median values of trade size and volatility, or having below average market capitalization (firm size), i.e. the controls used above.
[15] Note that only to describe ECN activity, only data for Instinet were used as the remaining ECNs only commenced operations after the end of their sample period.
[16] Conrad et al. (2001) offer the following ranking on aggressiveness : external crosses < ECN-executions < broker-dealer operations. These differences result in a natural sorting of order difficulty across the categories.

sample" approach[17] and a regression-based approach[18] as in Weston[19]. Both these methods yield quite similar results. Compared to traditional brokers, execution costs on crossing systems are substantially lower. For ECNs, this cost advantage is even more pronounced. Note that these results are quite robust and that the differences can be primarily attributed to distinct implicit costs.

Conrad, Johnson and Wahal (2001) note, however, that an endogeneity problem may arise as the choice of trading mechanism could be endogenous to (ex post) realized execution costs. Orders that are more difficult to fill, and thus incur higher ex post execution costs, are more likely to be sent to mechanisms guaranteeing a high fill rate. This issue, which leads to inconsistent estimates, is not accounted for in the above mentioned methods and therefore needs to be addressed by using a two-stage procedure ("endogenous switching regression method") following Madhavan and Cheng (1997). The cost differentials described above seem to persist when applying this model, in fact they are even more pronounced.

2) Depth of the Market

Besides performing a bid-ask spread comparison, Weston (2001) also investigates whether the increase in ECN market share leads to greater depths. For this purpose, he performs the following regression:

$$Depth_{it} = a_0 + a_1 ECNactivity_{it} + a_2 \ln(volume)_{it} + a_3 \ln(price)_{it} + a_4 \ln(volatility)_{it}$$

$$+ a_5 \ln(MarketConcentration)_{it} + a_6 TimeDummy_t + \boldsymbol{e}_{it}$$

[17] Which controls for trade direction, order instruction, order size, exchange listing and market capitalization without imposing any functional form restrictions.
[18] Control variables : order size, inverse of stock price, logarithm of market capitalization, exchange listing, return volatility, cumulative size-decile adjusted return, institution-specific indicator variables, indicator variables for external crosses and ECN-executed orders.
[19] Note that another possibility for comparing execution costs is focusing on multiple mechanism orders, as order characteristics by definition are held constant across the trades. Also the investor chooses how to break up the order, and where and in what sequence to place the order.

The presence of an ECN does seem to increase the quoted depth ceteris paribus by 11,6 percent. A one percent increase in ECN activity improves quoted depth by 0,27 percent all other variables held constant. So ECN activity improves the total quality of the market. These conclusions, however, are disputed by Barclay, Hendershott and McCormick (2001) who study transactions data for June 2000 and conclude that ECN trading lowers quoted depths.

3) Informational Efficiency

Weston (2001) suggests that ECNs do impose higher adverse selection costs on traditional markets through more anonymous trading[20]. An increase in anonymity through ECN trading may therefore increase information costs, urging intermediaries to charge larger spreads (Amihud and Mendelson (1986), Glosten and Harris (1988)). So, although ECNs lower trading costs (cfr. supra), they reduce the informational efficiency of prices. Note that this conjecture does not hold if the ECN functions as a separate market. In this case the presence of an ECN reduces the amount of information asymmetry in a dealer market by providing an alternative venue for information-based trades. Weston performs a test on the change in anonymity of trading on the Nasdaq due to ECN trading, i.e. estimating the adverse selection component of spread (Huang and Stoll (1997)) and regressing this measure on the level of ECN activity and a group of control variables[21]. An increase in adverse selection costs linked to ECN trading is noticed, confirming the first conjecture stated above. However, these costs are outweighed by benefit of lower overall transaction costs.

4) Price Discovery

Conrad, Johnson and Wahal (2001) describe the link between the efficiency of the primary markets' price discovery mechanism and the success of ECNs. For the United

[20] Intermediaries face uncertainty on the type of trader they deal with, i.e. informed or uninformed ones.
[21] These control variables include market capitalization, share turnover, return volatility and market concentration, and are also suspected to affect information costs.

States, it has been extensively proven that transaction costs are significantly lower on the NYSE than on Nasdaq (for example Hasbrouck (1995), Huang and Stoll (1996)). An obvious rationale for this difference is the distinction in trading mechanisms that are employed on both markets, i.e. auction markets provide more adequate price discovery than the dealership markets. In their study, they refer to Hendershott and Mendelson (2000), who state two necessary conditions for crossing systems to be successful when co-existing with a dealer market. Firstly, as these systems do not provide active price discovery themselves, they need to rely on a primary market providing an adequate price discovery mechanism. Secondly, the crossing network initially needs to attract at least a minimum threshold of volume from this primary market so that the pool of liquidity is sufficiently large[22]. Based on these conditions, one could postulate that crossing networks will be more successful in competing for NYSE shares and therefore primarily focus on listed securities. ECNs on the other hand, engage themselves in active price discovery, and will therefore rather compete with primary markets with higher transaction costs and fragmented order flow[23]. In fact, their success is inversely related to the efficiency of the primary market, i.e. if bid-ask spreads are higher on the primary market, ECNs become a truly competitive alternative[24]. Clearly, external crossing systems and ECNs compete for order flow in different dimensions as certain clientele effects arise. Empirical evidence seems to support both these conjectures as 90 percent of all orders executed on external crossing systems are for NYSE securities and 80 percent of all ECN-executed orders are for Nasdaq securities (sample by Conrad, Johnson and Wahal (2001)).

IV.2. Empirical Evidence for Europe

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[22] Referring to the Hendershot and Mendelson paper, Conrad et al. quote that "Volume on crossing systems that provide no price discovery function has a natural upper bound since the system cannot exist independent of the primary price-setting mechanism, whether it be an auction or dealer market. To the extent that other systems (such as ECNs) provide a price discovery mechanism, they can exist and grow independently."

[23] ECNs do make a significant contribution to price discovery and therefore do not necessarily engage free-riding off of price discovery by traditional dealers on Nasdaq (Huang (2000)).

[24] Note that a major determinant of the higher bid-ask spread on Nasdaq is the difference in anonymity, i.e. the Nasdaq market structure is more anonymous than the NYSE (Garfinkle and Nimalendran (1998) en Heidle and Huang (2000)) leading to higher adverse selection costs and thus to higher spreads.

It is a much more difficult exercise to gauge the importance of ATS in comparison to the European exchanges. ECNs, like Instinet, are brokers/dealers allowing investors to trade on several European exchanges. The two most prominent ECNs that are active on the European market are Tradepoint and Jiway.

1) *Tradepoint*

   Tradepoint recently merged with Swiss Exchanges into Virt-X, which is an attempt to create a pan-European blue chip exchange. Using unprecedented technology, their aim is to become competitive by providing the scope for significant reduction in cross border transaction costs at each stage of the trading, clearing and settlement process. Trading on a sectoral base is encouraged, rather than trading on a national base. Their aim is to "capture ten percent of the pan-European blue chip trading within twelve months" (cfr. site www.virt-x.com). Actually the market's structure (i.e. a continuous electronic public limit order book with opening, intra-day and closing single price auctions and full anonymity and facilities to support liquidity providers and off book and block trading requirements) strongly resembles the one offered by auction markets (cfr. infra).

2) *Jiway*

   Jiway, an initiative of OM Grüppen and Morgan Stanley Dean Witter combines a limit order book and market makers[25]. Its major focus is giving retail investors greater access to European and American stock markets. Thus it aims at small orders and tries to internationalize the retail market so as to improve liquidity on these markets.

Next to the ECNs, there are at least two crossing networks active in European stocks, i.e. ITG-Europe's POSIT and E-Crossnet. It is difficult to obtain estimates of their

[25] Note that meanwhile (as of September 2001), M.S.D.W. sold their stake integrally to OM Grüppen.

activity. However, in sum and up to now, ATS in Europe are far less important than in the United States.

1) ITG-Europe's POSIT

Since 1998, institutional investors and broker dealers can trade on ITG Europe's POSIT, a crossing system that is active in shares of eight European countries. Anonymity is guaranteed to reduce market impact.

2) E-Crossnet

Since 1999, E-Crossnet operates in 14 European countries and also aims at institutional investors and broker dealers. Its objectives, structure and dealing mechanism are roughly comparable to those of POSIT.

The empirical evidence on the interaction between ATS and market quality for Europe is rather scarce. Board and Wells (1999) offer a comparison of SETS (traditional exchange) and Tradepoint (ECN) concerning liquidity and best execution of UK shares. Therefore they compare prices available on those two exchanges, in fact the extent of price improvement opportunities is measured and analyzed.[26] Their analysis indicated that while SETS was clearly more active during the period under consideration, Tradepoint managed to offer better prices for between 45 and 90 minutes per trading day, at volumes that were roughly comparable to those offered by SETS. The reason why they still did not manage to attract sufficient trading volume, although being cheaper, is attributed to insufficient depth. Board and Wells propound that "if the other ECNs that are operating or planning to operate display similar results as Tradepoint, and particularly if they attract significant business, then there will be significant periods of the day in which the SETS price is not the most attractive price."

[26] The comparison is executed towards some specific factors, e.g. the availability of best prices on the two markets, the spread on each market, available depth at best prices, etc.

Note that most of the empirical evidence for the impact of ECNs on traditional exchanges for the United States concerns Nasdaq (cfr. supra), which is a dealer market. Therefore, the stated findings and insights do not necessarily apply for Europe where most of the stock markets offer an electronic auction-based mechanism. As this sort of trading system is quite analogous to the one offered by ECNs, they will probably even face difficulties in attracting trade volumes. Clearly, the traditional markets, acting as incumbents, enjoy a major liquidity externality, implying difficulties for ECNs in capturing a market segment of their own. Moreover, it is clear that ECNs have not flourished to such an extent in the European markets so far, because the traditional exchanges have been proactive in addressing the changing needs of investors, i.e. in creating efficient trading facilities themselves.
Intuitively, we expect crossing networks to be relatively more successful than ECNs for Europe. To reach this conclusion, we extend the Conrad, Johnson and Wahal (2001) results on price discovery to the European "auction market" case. Unfortunately there is no evidence reported so far concerning the magnitude of trading on crossing networks. Initiatives as E-Crossnet and ITG Europe's POSIT (cfr. supra), however, demonstrate that these kinds of networks can indeed be erected. Given these arguments, one could expect the traditional markets to create their own passive call market in the future, parallel to their own market.

In the market microstructure literature, previous studies have investigated whether the trading activity of a dually-traded stock on one market has an effect on trading activity on the other one (and thus not necessarily on the spread). Pagano and Röell (1991) initiated this research methodology and investigated whether trading of Italian equities on SEAQ International implied trade diversion or trade creation for the Milan Stock Exchange. This methodology has been replicated by e.g. Anderson and Tychon (1993) and Degryse (1996) for the impact of SEAQ International on Belgian equities.
We will now apply this methodology to test whether a variable related to trading activity on an ECN (Virt-X) helps to explain trading volume on the "local" exchange (Paris Bourse). Trading on ECNs may have displaced activity from the local exchange to the ECN. Alternatively, it may also have generated a stimulus in trading as some institutional investors find the source of or outlet for the shares dealt at the ECN. Our

dataset consists of weekly trading data for an eight-month period on the Paris Bourse and on Virt-X. Functioning as dependent variable for our regressions is the volume on the Paris Bourse exchange for ten randomly selected dually traded stocks that are all members of the CAC40 index[27]. Next to the Virt-X volume variable, explanatory variables are lagged values of the dependent variable, current and lagged values of total market volume, current and lagged values of the average return and the volatility of the relevant stock (respectively measured by the monthly average and the standard deviation of daily returns)[28]. These are included to control for other possible determinants of trading volume, a choice that is based on Pagano and Röell (1991). A negative and significant coefficient for the Virt-X volume variable is interpreted as a symptom of trade diversion from the Paris Bourse to Virt-X. A positive significant one indicates trade creation. Most of our regressions (9 out of 10), however, generate a negative but insignificant coefficient indicating no effect at all. Note that this is probably due to the small time span of the sample. We expect the effect to increase, within certain boundaries (cfr. supra), as Virt-X will continue being operative. Clearly a period of almost three months, in which its introduction to the financial markets occurred, is rather short to state any strong conclusions on its impact. Moreover, our estimated coefficients could also capture some sort of “summer effect”, as the introduction of Virt-X coincides with the summer break. This obviously limits our results.

V. Concluding Remarks

The purpose of this paper was to discuss the relationship between alternative trading systems (ATS) and liquidity. Two important trends can be distinguished. First, ATS are currently more successful in the United States than in Europe. Second, within the United States, there exists an interesting divergence between the impact of ATS on the Nasdaq dealer market and on the NYSE. ATS are attracting about 30 per cent of

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[27] Namely for Alcatel, Aventis, Axa, Carrefour, Eurotunnel, France Telecom, Orange, Renault, Usinor and Vivendi.

[28] Note that replacing the Virt-X volume variable by a dummy variable as in Pagano and Röell (1991) does not change our results.

market share in the Nasdaq market, whereas their impact on the NYSE is rather small. Trading volume on ATS in Europe is currently still marginal compared to the established market places.

Two forces explaining these differences should be distinguished. The first is that European traditional market places were earlier automated than their American counterparts. International evidence shows that automation reduces transaction costs considerably. ATS are the exponent of automated systems and should therefore be more successful in the United States. Our empirical work shows that automation also has a significant impact on trading costs in Europe, but still less substantial than in an international context. This observation brings us to a second explanation, i.e. the agency nature of trading. European markets are mostly organized as an auction market where traders can submit market and limit orders. ECNs allow investors to trade with each other via a limitorder book without the intervention of a dealer. This market microstructure is close to the one of incumbent European exchanges (e.g. Euronext). Therefore ECNs are successful in attracting Nasdaq trading volume and are expected to be less successful in competition with the NYSE or European exchanges. Crossing networks are more successful in realizing trades of NYSE listed securities. This leads us to the projection that crossing networks may be a more successful ATS business model in Europe than ECNs.

Several studies discuss the impact of ATS on the market quality/liquidity of American markets. Bid-ask spreads seem to decrease due to competition of electronic communication networks. Thus competition seems to be more important than fragmentation of markets. The results on market depth are inconclusive. ECNs reduce the informational efficiency of the market. The reason is that ECNs typically allow for anonymous trading, leading to an increase in the adverse selection component of the spread. Crossing networks rely on price discovery at the primary exchange while ECNs actively contribute to the price discovery process.

Currently, trading volume on alternative trading systems in Europe is rather low compared to the established market places. Consistent with this, our empirical work does not reveal significant trade diversion or trade creation effects of Virt-X on the incumbent European exchanges. Evidence from the interaction between Tradepoint and SETS shows that ATS may face a problem of market depth in Europe.

REFERENCES

Amihud, Y. and Mendelson, H. (1986) Asset pricing and the bid-ask spread, *Journal of Financial Economics* 17, pp. 223-249.

Anderson, R. and Tychon, P. (1993) Competition among European financial markets: the case of cross-listed Belgian equities, IRES discussion paper nr. 9314.

Barclay, M., Hendershott, T. and McCormick, T. (2001) Electronic communications networks and market quality, working paper, University of Rochester.

Benhamou, E. and Serval, T. (2000) On the competition between ECNs, stock markets and market makers, Financial Markets Group discussion paper.

Board, J. and Wells, S. (1999) Liquidity and best execution in the UK: a comparison of SETS and Tradepoint, Financial Markets Group discussion paper.

Conrad, J., Johnson, K. and Wahal, S. (2001) Alternative trading systems, working paper.

Christie, W. and Schultz, P. (1994) Why do Nasdaq market makers avoid odd-eighth quotes?, *Journal of Finance* 49, pp. 1813-1840.

Degryse, H. (1996) Competition between auction and dealership markets: Brussels versus London, *Revue de la Banque/Bank-en Financiewezen*, pp. 378-386.

Demsetz, H. (1968) The cost of transacting, *Quarterly Journal of Economics* 82, pp. 33-53.

Domowitz, I. (2001) Liquidity, transaction costs, and reintermediation in electronic markets, working paper.

Domowitz, I., Glen, J. and Madhavan, A. (2001) Global equity trading costs, working paper.

Domowitz, I. and Steil, B. (1999) Automation, trading costs, and the structure of the securities trading industry, Brookings-Wharton papers on Financial Services.

Glosten, L. and Harris, L. (1988) Estimating the components of the bid/ask spread, *Journal of Financial Economics* 21, pp. 123-142.

Glosten, L. and Milgrom, P. (1985) Bid, ask, and transaction prices in a specialist market with heterogeneously informed traders, *Journal of Financial Economics* 14, pp. 71-100.

Hasbrouck, J. (1995) One security, many markets: determining the contributions to price discovery, *Journal of Finance* 50, pp. 1175-1199.

Hendershott, T. and Mendelson, H. (2000) Crossing networks and dealer markets: competition and performance, *Journal of Finance* 55, pp. 2071-2116.

Huang, R. (2000) Price discovery by ECNs and Nasdaq market makers, working paper, University of Notre Dame.

Huang, R. and Stoll, H. (1996) Dealer vs. auction markets: a paired comparison of execution costs on Nasdaq and the NYSE, *Journal of Financial Economics* 41, pp. 313-357.

Ho, T. and Stoll, H. (1981) Optimal dealer pricing under transactions and return uncertainty, *Journal of Financial Economics* 9, pp. 47-73.

Madhavan, A. (2000) Market microstructure: a survey, *Journal of Financial Markets* 3, pp. 205-258.

Madhavan, A. and Cheng, M. (1997) In search of liquidity: block trades in the upstairs and downstairs markets, *Review of Financial Studies* 10, pp. 175-203.

Milbourn, T., Boot, A. and Thakor, A. (1999) Megamergers and expanded scope: theories of bank size and activity diversity, *Journal of Banking and Finance* 23, 195-214.

Naes, R. and Odegaard, B.A. (2001) Equity trading by institutional investors: to cross or not to cross?, working paper, Norwegian School of Management.

Pagano, M. and Röell, A. (1991), Dually-traded Italian equities: London vs. Milan, CEPR discussion paper nr. 564.

Salomon Smith Barney (2001) Trading ip: The new world of electronic trading, research report.

Securities and Exchange Commission Report (S.E.C.) (2000).

Simaan, Y., Weaver, D. and Whitcomb, D. (1998) The quotation behavior of ECNs and Nasdaq market makers, working paper, Baruch College.

Stoll, H. (1992) Principles of trading market structure, *Journal of Financial Services Research* 6, pp. 75-106.

Wahal, S. (1997) Entry, exit, market makers, and the bid-ask spread, *Review of Financial Studies* 10, pp. 871-901.

Weston, J. (2000) Electronic communication networks and liquidity on the Nasdaq,

working paper.
Weston, J. (2001) Competition on the Nasdaq and the growth of electronic communication networks, working paper.

Table 1: Total trading costs in 42 countries

Country	1996 (basis points)	1997 (basis points)	1998 (basis points)	1999 (basis points)
Argentina	93.1	59.7	48.7	62.7
Australia	57.0	53.8	47.0	54.2
Austria	40.3	39.9	54.1	42.7
Belgium	37.1	31.1	33.9	27.9
Brazil	63.1	53.7	46.6	47.1
Canada	63.0	51.6	43.9	39.9
Chile	115.4	60.4	47.0	131.0
Colombia	99.6	91.7	95.1	96.3
Czech republic	134.6	150.5	161.0	71.2
Denmark	35.7	45.4	43.4	41.1
Finland	41.9	42.3	44.0	40.7
France	29.9	26.7	26.6	24.9
Germany	39.3	33.3	27.6	28.7
Greece	64.4	66.9	63.6	87.3
Hong kong	59.2	56.6	50.1	43.7
Hungary	145.2	163.7	102.3	71.6
India	85.8	65.0	64.8	128.7
Indonesia	108.5	92.4	95.5	84.8
Ireland	153.3	105.1	99.4	71.9
Italy	36.1	29.7	30.4	34.2
Japan buy	30.6	26.5	18.2	25.1
Japan sell	56.0	47.1	36.3	25.1
Luxembourg	75.5	73.0	70.0	102.3
Malaysia	87.3	87.8	90.8	90.7
Mexico	69.3	54.7	61.0	55.6
Netherlands	69.3	25.8	30.0	28.4
New Zealand	53.6	38.5	38.9	35.3
Norway	46.1	34.0	36.4	34.4
Peru	93.9	80.1	76.0	89.6
Philippines	114.9	107.5	105.0	109.0
Portugal	62.7	59.9	41.1	42.7
Singapore	71.9	76.6	84.9	64.9
South Africa	89.6	68.3	58.5	80.1
South korea	228.9	200.1	97.8	78.9
Spain	47.1	34.9	43.0	42.3
Sweden	36.1	30.6	30.9	31.5
Switzerland	37.1	44.0	46.0	36.5
Taiwan	72.9	66.5	56.8	54.0
Thailand	93.8	87.2	75.5	82.6
Turkey	77.2	68.4	57.1	40.5
Uk buy	73.7	75.1	71.0	71.1
Uk sell	32.8	30.1	34.2	30.5
Us nyse	34.1	31.5	23.6	24.6
Us otc	51.9	39.0	29.9	33.3
Venezuela	113.4	158.4	144.7	195.8
Average	73.2	65.9	59.6	60.8

Source: Institutional Investor

Table 2: Electronic Trading Systems in Europe

European Exchange	Electronic since
Amsterdam	1994
Austria	1999
Borsa Italiana	1994
Brussels	1996
Copenhagen	1999
Deutsche Borse	1992
Finland	1997
London Stock Exchange	1997
Madrid	1989
Oslo	1999
Paris Bourse	1988/1994
Stockholm	1989
Switzerland	1996

Source: Internet and Salomon Smith Barney

Table 4: ECN Characteristics (US)

ECN	Archipelago	ATTAIN	Bloomberg Tradebook	BRUT/Strike	Instinet	Island	MarketXT	NEXTRADE	REDIBOOK
Starting date	01/97	02/98	12/96	05/98	1969	01/97	01/00	11/98	11/97
Ownership by strategic partners	Yes	Not yet	No	Yes	Reuters	Yes	-	-	Yes
Strategic partnerships	Tradepoint	-	-	-	Yes	-	Yes	Yes	-
Technology	Internal book SORT Plans to form exchange	Internal book	Internal book SORT Agency broker	Internal book SORT	Internal book Agency broker Block trades	Internal book	Mainly after hours trade SORT	Internal book SORT Exchange application pending	Internal book SORT
Trade volume as % of Nasdaq (last quarter 2000)	1.9%	0%	1.3%	1.8%	13%	7.1%	0%	0%	1.7%

Source: internet